

PATENT ABSTRACTS OF JAPAN

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(54) CONED DISC SPRING CONTACT MADE OF PALLADIUM COVERED STAINLESS STEEL AND SWITCH USING THE SAME

(57)Abstract:

PROBLEM TO BE SOLVED: To prolong the life of a switch by forming an undercoating layer of Ni, Co, or their alloy on the surface of a stainless steel base material, forming a Pd layer on the undercoating layer, and using this material for a coned disc spring contact.

SOLUTION: An undercoating layer of Ni, Co, or alloy of them is formed on a stainless steel base material, and on the undercoating layer, a Pd layer or a Pd alloy layer surely providing low contact resistance is formed. When this material is used for coned disc spring contact, adhesive wear or the like hardly occurs. Since the stainless steel base material contributing mechanical strength for the a coned disk spring contact, a rolled quenched material or tension annealed material, which is superior in a stress relaxation characteristic and hardly broken because of fatigue, is used. The undercoating layer increases adhesiveness between the stainless steel, and the Pd layer and prevents diffusion of a harmful element from the base material to the Pd layer. In addition, adhesive wear can be suppressed further, when flash plating of Au is applied onto the Pd layer. For forming the undercoating layer, the Pd layer, and the Au layer, an electroplating method is advantageous.

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ABSTRACT:

PROBLEM TO BE SOLVED: To prolong the life of a switch by forming an undercoating layer of Ni, Co, or their alloy on the surface of a stainless steel base material, forming a Pd layer on the undercoating layer, and using this material for a coned disc spring contact.

SOLUTION: An undercoating layer of Ni, Co, or alloy of them is formed on a stainless steel base material, and on the undercoating layer, a Pd layer or a Pd alloy layer surely providing low contact resistance is formed. When this material is used for coned disc spring contact, adhesive wear or the like hardly occurs. Since the stainless steel base material contributing mechanical strength for the a coned disk spring contact, a rolled quenched material or tension annealed material, which is superior in a stress relaxation characteristic and hardly broken because of fatigue, is used. The undercoating layer increases adhesiveness between the stainless steel, and the Pd layer and prevents diffusion of a harmful element from the base material to the Pd layer. In addition, adhesive wear can be suppressed further, when flash plating of Au is applied onto the Pd layer. For forming the undercoating layer, the Pd

layer, and the Au layer, an electroplating method is advantageous.

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CLAIMS

[Claim(s)]

[Claim 1] Pan spring contact which consists of Pd covering stainless steel with which the substrate layer of nickel, Co, nickel alloy, or Co alloy was formed in a part of front face [at least] of a stainless steel base material, and Pd layer or Pd alloy layer was formed on it.

[Claim 2] Pan spring contact which consists of Pd covering stainless steel with which the substrate layer of nickel, Co, nickel alloy, or Co alloy is formed in a part of front face [at least] of a stainless steel base material, Pd layer or Pd alloy layer is formed on it, and flash plate plating of the Au is further carried out on it.

[Claim 3] Pan spring contact which consists of Pd covering stainless steel according to claim 1 or 2 characterized by carrying out surface treatment with the processing liquid which contains high-class fatty amine or a mercaptan 0.05 to 5% of the weight.

[Claim 4] Pan spring contact to which the thickness of a substrate layer becomes either of claims 1, 2, and 3 characterized by 0.05 to 4.0 micrometer, Pd layer, or Pd alloy layer thickness being 0.01 to 2.0 micrometer from Pd covering stainless steel of a publication.

[Claim 5] The switch characterized by using the pan spring contact which consists of Pd covering stainless steel indicated by either of claims 1, 2, 3, and 4.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the switch using the pan spring contact which consists of Pd covering stainless steel with which the switch life has been improved, and said pan spring contact.

[0002]

[Description of the Prior Art] Pan spring contact is mainly used for the electric contact sections, such as a connector, a switch, and a terminal. To this pan spring contact, a copper alloy, stainless steel, etc. are comparatively cheap, and the composite contact ingredient which carried out partial plating of the gold or silver which is excellent in the base material which is excellent in corrosion resistance, a mechanical property, etc. at an electrical property and soldering nature is used abundantly at it. Since what used stainless steel for the base material among said composite contact ingredients excels what used the copper alloy in a mechanical property, a fatigue life, etc., the miniaturization of a contact is possible for it, and it began to be used for traveling contacts, such as a TAKUTIRU push switch and a pilot switch.

[0003]

[Problem(s) to be Solved by the Invention] However, the further improvement is desired long [a switch life] enough by the pan spring contact which uses the conventional stainless steel as a base material. In what carried out partial plating of Ag, the cause which is not long enough is for a contact side to carry out adhesive wear, and for a base material to be exposed, or for Ag layer to carry out sulfuration discoloration, and is for a contact side to carry out adhesive wear of the Au in what carried out partial plating, and for Au layer to deteriorate. This invention aims at offer of the switch using the pan spring contact which consists of Pd covering stainless steel with which the switch life has been improved, and said pan spring contact.

[0004]

[Means for Solving the Problem] Invention according to claim 1 is pan spring contact which consists of Pd covering stainless steel with which the substrate layer of nickel, Co, nickel alloy, or Co alloy was formed in a part of front face [at least] of a stainless steel base material, and Pd layer or Pd alloy layer was formed on it.

[0005] Invention according to claim 2 is pan spring contact which consists of Pd covering stainless steel with which the substrate layer of nickel, Co, nickel alloy, or Co alloy is formed in a part of front face [at least] of a stainless steel base material, Pd layer or Pd alloy layer is formed on it, and flash plate plating of the Au is further carried out on it.

[0006] Invention according to claim 3 is pan spring contact which consists of Pd covering stainless steel according to claim 1 or 2 characterized by carrying out surface treatment with the processing liquid which contains high-class fatty amine or a mercaptan 0.05 to 5% of the weight.

[0007] Invention according to claim 4 is pan spring contact which becomes either of claims 1, 2, and 3 to which thickness of a substrate layer is characterized by 0.05 to 4.0 micrometer, Pd layer, or Pd alloy layer thickness being 0.01 to 2.0 micrometer from Pd covering stainless steel of a publication.

[0008] Invention according to claim 5 is a switch characterized by using the pan spring contact which

consists of Pd covering stainless steel indicated by either of claims 1, 2, 3, and 4.
[0009]

[Embodiment of the Invention] Invention of claim 1 is the pan spring contact using Pd covering stainless steel in which Pd layer or Pd alloy layer (it is hereafter named Pd layer generically) from which low contact resistance is obtained by being stabilized in substrate layers, such as nickel, at a top was formed on the stainless steel base material, and adhesion wear etc. cannot occur easily. In this invention, a stainless steel base material bears the mechanical strength of pan spring contact, and the rolling temper material or tension annealing material which cannot excel and carry out fatigue breaking to a stress relaxation characteristic easily, such as SUS301, SUS304, and SUS316, are used. The duty which prevents that the substrate layer formed on said stainless steel base material raises the adhesion between stainless steel and Pd layer, and tramp elements diffuse it from a stainless steel base material to Pd layer is achieved. Contact resistance is stabilized by Pd layer formed on said substrate layer, and since it is low, adhesion wear of a contact side etc. is controlled.

[0010] Invention of claim 2 is the pan spring contact by which flash plate plating (ultra-thin plating performed for a short time) of the Au was carried out to Pd layer of pd covering stainless steel of invention of claim 1, and adhesion wear of a contact side is controlled more certainly. The effectiveness saturates and is uneconomical, even if the effectiveness is not fully acquired but makes thickness of said flash plate plating of Au thicker than 0.2 micrometers by less than 0.001 micrometers. Therefore, 0.001 to 0.2 micrometer is desirable.

[0011] In invention of claims 1 and 2, although a substrate layer, Pd layer, Au layer, etc. can be formed by the approaches of arbitration, such as electroplating, a nonelectrolytic plating method, and physics, chemical vapor deposition, electroplating is the most advantageous from the field of productivity and cost. Although said substrate layer, Pd layer, etc. may be formed all over a stainless steel base material, to form only in a contact surface is more economical. In addition, the board thickness of a disk spring has common about 20-200 micrometers.

[0012] Invention of claim 3 is the pan spring contact which carried out surface treatment of the pan spring contact according to claim 1 or 2 with the processing liquid containing high-class fatty amine or a mercaptan, sealing of the pinhole of Pd layer or Au layer is carried out by this surface treatment, corrosion resistance is improved, and lubricity is given to Pd layer or Au layer, and a switch life is improved further. As for this surface treatment, it is rich [productivity], and desirable to give Pd covering stainless steel before processing it into pan spring contact. At less than 0.05%, if the effectiveness is not fully acquired but exceeds 5%, high-class fatty amine or a mercaptan will adhere superfluously, and, as for the high-class fatty amine of said processing liquid, or the concentration of a mercaptan, contact resistance will go up. Therefore, the concentration of said processing liquid is specified to 0.05 - 5% of the weight (it is hereafter written as %). The approach immersed in said processing liquid, the approach of carrying out the spray of said processing liquid, or applying with the brush, etc. are applied to the approach of said surface treatment.

[0013]

[Example] Below, an example explains this invention at a detail.

(Example 1) It let continuously 301 articles (0.06 mm thickness, 100mm of *****) of SUSSs pass to an electrolytic-degreasing tub, a rinse tank, an electrolysis activity tub, a rinse tank, the substrate plating tub, Pd plating tub, Au flash plate plating tub, and the rinse tank, the substrate layer, Pd layer, and Au layer were formed in the 301 article front face of SUSSs at this order, and Pd covering stainless steel was manufactured. here, various thickness of each class was boiled and was changed. Some things were immersed in specified quantity **** processing liquid in high-class fatty amine or a mercaptan, and performed surface treatment.

[0014] (Example 2) The substrate layer and Pd layer were formed in the 301 article front face of SUSSs at this order, without letting Au flash plate plating tub pass, and also Pd covering stainless steel was manufactured by the same approach as an example 1.

[0015] Each obtained Pd covering stainless steel was processed into pan spring contact, this was included in the traveling contact of a TAKUTIRU push switch, and life test was performed. Here, the

brass material which formed Ag in 1-micrometer thickness was used for the stationary contact. The life test same also about elegance as usual which galvanized Au or Ag on R articles or the 301 article front face of C5210SUSs was performed. The test condition made 1Hz and the count of the maximum stroke, and made the test atmosphere three kinds of atmospheric air, a 80-degree C air furnace, and H₂S gas (ordinary temperature) for the working speed 2 million times. Contact resistance was measured for every stroke 10,000 times, and the count to which contact resistance exceeded 500mohm was made into the switch life. The configuration of a disk spring is shown in Tables 1 and 2, and a switch life is shown for a result in Tables 3 and 4. In Tables 3 and 4, the count of a stroke which the disk spring fractured was written together.

[0016]

[Table 1]

分類	No	基材	下地層 μm	Pd層 μm	Au,Ag 層 μm	表面処理 処理剤/濃度/時間
本 発 明 例 品	1	SUS -301 条	Ni 0.05	Pd 0.1	---	-----
	2		Ni 0.2	Pd-10%Ni 0.1	---	-----
	3		Ni 0.5	Pd 0.1	---	-----
	4		Ni 1.0	Pd 0.1	---	-----
	5		Ni 1.0	Pd 0.01	---	-----
	6		Co 1.0	Pd 0.05	---	アイコシルメルカブタン /0.1%/5秒
	7		Ni-10%Co 1.0	Pd 0.5	---	-----
	8		Ni 1.0	Pd 0.1	---	ドデシルアミン /0.5%/5秒
	9		Ni 1.0	Pd 0.1	Au 0.001	-----
	10		Ni 1.0	Pd 0.1	Au 0.01	-----

(Note) No.1-8 : An example 2, No.9-10: Example 1.

[0017]

[Table 2]

分類	No	基材	下地層 μm	Pd層 μm	Au,Ag 層 μm	表面処理 処理剤／濃度／時間
本発明例品	11	SUS 301 条	Ni 1.0	Pd 0.1	Au 0.05	ドデシルメルカプタン /0.3%/5秒
	12		Ni 0.1	Pd 0.1	Au 0.2	---
	13		Ni 0.2	Pd 0.005	---	-----
	14		Ni 0.04	Pd 0.05	---	-----
	21		Ni 1.0	Pd 2.0	---	-----
	22		Ni 4.0	Pd 0.1	---	-----
従来品	16	C 5210	---	-----	Au 0.01	-----
	17		---	-----	Ag 1.0	-----
	18	SUS 301 条	---	-----	Au 0.05	-----
	19		---	-----	Ag 1.0	-----

(Note) No.11-12: An example 1, No.13, 14 and 21, 22:example 2.

[0018]

[Table 3]

分類	No	イッヂ寿命 (接触抵抗が500mΩを超えた回数)			ばね破断回数 (常温) 回
		常温	80℃	H ₂ S 3ppm	
本発明例品	1	120×10 ⁶	131×10 ⁶	104×10 ⁶	>200×10 ⁶
	2	172×10 ⁶	107×10 ⁶	132×10 ⁶	"
	3	151×10 ⁶	148×10 ⁶	121×10 ⁶	"
	4	142×10 ⁶	154×10 ⁶	137×10 ⁶	"
	5	105×10 ⁶	112×10 ⁶	106×10 ⁶	"
	6	169×10 ⁶	>200×10 ⁶	193×10 ⁶	"
	7	>200×10 ⁶	>200×10 ⁶	>200×10 ⁶	"
	8	>200×10 ⁶	189×10 ⁶	>200×10 ⁶	"
	9	173×10 ⁶	160×10 ⁶	169×10 ⁶	"
	10	186×10 ⁶	>200×10 ⁶	>200×10 ⁶	"

(Note) No.1-8 : An example 2, No.9-10: Example 1.

[0019]

[Table 4]

分類	No	スイッチ寿命 (接触抵抗が500mΩを超えた回数)			ばね破断回数 (常温) 回
		常温	80°C	H ₂ S 3ppm	
本発明例品	11	> 200×10 ⁶	> 200×10 ⁶	> 200×10 ⁶	> 200×10 ⁶
	12	> 200×10 ⁶	> 200×10 ⁶	192×10 ⁶	> 200×10 ⁶
	13	90×10 ⁶	86×10 ⁶	69×10 ⁶	190×10 ⁶
	14	83×10 ⁶	74×10 ⁶	61×10 ⁶	170×10 ⁶
	21	> 200×10 ⁶	> 200×10 ⁶	> 200×10 ⁶	> 200×10 ⁶
	22	175×10 ⁶	110×10 ⁶	120×10 ⁶	> 200×10 ⁶
従来品	16	44×10 ⁶	31×10 ⁶	27×10 ⁶	80×10 ⁶
	17	23×10 ⁶	12×10 ⁶	19×10 ⁶	75×10 ⁶
	18	65×10 ⁶	5.2×10 ⁶	45×10 ⁶	172×10 ⁶
	19	62×10 ⁶	37×10 ⁶	42×10 ⁶	170×10 ⁶

(Note) No.11-12: An example 1, No.13, 14 and 21, 22:example 2.

[0020] For each of No.1-14 of the example article of this invention, and 21 and 22, a switch life is elegance (No.16-19) conventionally so that more clearly than Tables 3 and 4. Are long. What formed Pd layer thickly especially (7 No. 21), the thing (10 No. 12) which formed Au layer thickly, the thing (6 No. 8) which carried out surface treatment, and thing which formed Au layer and carried out surface treatment further (No.11) The especially excellent life property was shown. Pd layer is thinner. No.13 and a substrate layer are thinner. No.14 were extent which is satisfactory practically, although the switch life and the count of spring fracture fell a little.

[0021]

[Effect of the Invention] As stated above, it consists of Pd covering stainless steel with which the pan spring contact of this invention formed substrate layers, such as nickel, on the stainless steel base material, and formed Pd layer on it, or Pd covering stainless steel which carried out flash plate plating of the Au further on said Pd layer, contact resistance is stabilized by said Pd layer, and since it is low, adhesion wear etc. cannot occur in a contact surface easily. Moreover, as for what carried out surface treatment of said Pd covering stainless steel with predetermined processing liquid, adhesion wear etc. cannot occur further easily. Therefore, a life is long and the switch using the pan spring contact of this invention is reliable. Moreover, the pan spring contact of this invention is suitable for a miniaturization, and can be applied to an application large as a traveling contact of a TAKUTIRU push switch etc. Therefore, remarkable effectiveness is done so on industry.

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(54)【発明の名称】 Pd被覆ステンレス鋼からなる皿ばね接点および前記皿ばね接点を用いたスイッチ

(57)【要約】

【課題】 スイッチ寿命が改善されたPd被覆ステンレス鋼からなる皿ばね接点および前記皿ばね接点を用いたスイッチを提供する。

【解決手段】 ステンレス鋼基材の表面の少なくとも一部にNi、Co、Ni合金またはCo合金の下地層が形成され、その上にPd層またはPd合金層が形成されたPd被覆ステンレス鋼からなる皿ばね接点。前記皿ばね接点を用いたスイッチ。

【効果】 ステンレス鋼基材上にNiなどの下地層を、その上にPd層を形成したPd被覆ステンレス鋼、または前記Pd層上にさらにAuをフラッシュめっきしたPd被覆ステンレス鋼からなり、前記Pd層は接触抵抗が安定して低いため接点部に凝着磨耗などが起き難い。また前記Pd被覆ステンレス鋼を所定の処理液で表面処理したものは凝着磨耗などがさらに起き難い。従って、本発明の皿ばね接点を用いたスイッチは寿命が長く信頼性が高い。

【特許請求の範囲】

【請求項1】 ステンレス鋼基材の表面の少なくとも一部にNi、Co、Ni合金またはCo合金の下地層が形成され、その上にPd層またはPd合金層が形成されたPd被覆ステンレス鋼からなる団ばね接点。

【請求項2】 ステンレス鋼基材の表面の少なくとも一部にNi、Co、Ni合金またはCo合金の下地層が形成され、その上にPd層またはPd合金層が形成され、さらにその上にAuがフラッシュめつきされているPd被覆ステンレス鋼からなる皿ばね接点。

【請求項3】 高級脂肪族アミンまたはメルカプタンを0.05～5重量%含む処理液により表面処理されていることを特徴とする請求項1または2記載のPd被覆ステンレス鋼からなるばね接点。

【請求項4】 下地層の厚さが0.05~4.0μm、Pd層またはPd合金層の厚さが0.01~2.0μmであることを特徴とする請求項1、2、3のいずれかに記載のPd被覆ステンレス鋼からなる皿ばね接点、

【請求項5】 請求項1、2、3、4のいずれかに記載されたPd被覆ステンレス鋼からなる皿ばね接点が用いられていることを特徴とするスイッチ。

【発明の詳細な説明】

[0001]

【発明の属する技術分野】本発明は、スイッチ寿命が改善されたPd被覆ステンレス鋼からなる皿ばね接点および前記皿ばね接点を用いたスイッチに関する。

[0002]

【従来の技術】コネクター、スイッチ、端子などの電気接点部には主に皿ばね接点が用いられている。この皿ばね接点には、銅合金やステンレス鋼などの比較的安価で、耐食性、機械的性質などに優れる基材に、電気特性と半田付け性に優れる金または銀を部分めっきした複合接点材料が多用されている。前記複合接点材料のうち、基材にステンレス鋼を用いたものは、銅合金を用いたものより機械的特性、疲労寿命などに優れるため接点の小型化が可能であり、タクティルプッシュスイッチや検出スイッチなどの可動接点に使用されだした。

[0003]

【発明が解決しようとする課題】しかし、従来のステンレス鋼を基材とする皿ばね接点はスイッチ寿命が十分には長くなく、さらなる改善が望まれている。前記皿ばね接点の寿命が十分に長くない原因は、A_gを部分めっきしたものでは接点面が凝着摩耗して基材が露出し或いはA_g層が硫化変色するためであり、A_uを部分めっきしたものでは接点面が凝着摩耗してA_u層が劣化するためである。本発明は、スイッチ寿命が改善されたPd被覆ステンレス鋼からなる皿ばね接点および前記皿ばね接点を用いたスイッチの提供を目的とする。

【0004】

【課題を解決するための手段】請求項1記載の発明は、

【0005】請求項2記載の発明は、ステンレス鋼基材の表面の少なくとも一部にNi、Co、Ni合金またはCo合金の下地層が形成され、その上にPd層またはPd合金層が形成され、さらにその上にAuがフラッシュめっきされているPd被覆ステンレス鋼からなる皿ばね

【0006】請求項3記載の発明は、高級脂肪族アミンまたはメルカプタンを0.05～5重量%含む処理液により表面処理されていることを特徴とする請求項1または2記載のPd被覆ステンレス鋼からなる皿ばね接点である。

【0007】請求項4記載の発明は、下地層の厚さが0.05~4.0μm、Pd層またはPd合金層の厚さが0.01~2.0μmであることを特徴とする請求項1、2、3のいずれかに記載のPd被覆ステンレス鋼からなる皿ばね接点である。

【0008】請求項5記載の発明は、請求項1、2、3、4のいずれかに記載されたPd被覆ステンレス鋼からなる皿ばね接点が用いられていることを特徴とするスイッチである。

[0009]

【発明の実施の形態】請求項1の発明は、ステンレス鋼基材上にN iなどの下地層を、その上に、低い接触抵抗が安定して得られるP d層またはP d合金層（以下、P d層と総称する）を形成したP d被覆ステンレス鋼を用いた皿ばね接点で、凝着磨耗などが起き難いものである。この発明において、ステンレス鋼基材は皿ばね接点の機械的強度を担うものであり、応力緩和特性に優れ疲労破壊し難いSUS301、SUS304、SUS316などの圧延調質材またはテンションアニール材が用いられる。前記ステンレス鋼基材上に形成される下地層は、ステンレス鋼とP d層との間の密着性を高め、またステンレス鋼基材からP d層へ有害元素が拡散するのを防止する役目を果たす。前記下地層上に形成されるP d層は、接触抵抗が安定して低いため、接点面の凝着磨耗などが抑制される。

【0010】請求項2の発明は、請求項1の発明のPd被覆ステンレス鋼のPd層にAuがフラッシュめっき（短時間で行う極薄めっき）された皿ばね接点で、接点面の凝着磨耗がより確実に抑制される。前記Auのフラッシュめっきの厚さは、0.001μm未満ではその効果が十分に得られず、0.2μmより厚くしてもその効果が飽和し不経済である。従って、0.001～0.2μmが望ましい。

【0011】請求項1、2の発明において、下地層、Pd層、Au層などは電気めっき法、無電解めっき法、物

理・化学的蒸着法など任意の方法により形成できるが、電気めっき法が生産性とコストの面から最も有利である。前記下地層、Pd層などはステンレス鋼基材の全面に形成しても良いが、接点部のみに形成した方が経済的である。なお、皿ばねの板厚は20~200μm程度が一般的である。

【0012】請求項3の発明は、請求項1または2記載の皿ばね接点を高級脂肪族アミンまたはメルカプタンを含む処理液により表面処理した皿ばね接点で、この表面処理によりPd層またはAu層のピンホールが封孔されて耐食性が改善され、またPd層またはAu層に潤滑性が付与されてスイッチ寿命が一層改善される。この表面処理は皿ばね接点に加工する前のPd被覆ステンレス鋼に施すのが、生産性に富み望ましい。前記処理液の高級脂肪族アミンまたはメルカプタンの濃度は0.05%未満ではその効果が十分に得られず、5%を超えると高級脂肪族アミンまたはメルカプタンが過剰に付着して接触抵抗が上昇する。従って、前記処理液の濃度は0.05~5重量%（以下、%と略記する）に規定する。前記表面処理の方法には、前記処理液に浸漬する方法、前記処理液をスプレーするか刷毛で塗布する方法などが適用される。

【0013】

【実施例】以下に、本発明を実施例により詳細に説明する。

（実施例1）SUS301条（厚さ0.06mm、条幅100mm）を、電解脱脂槽、水洗槽、電解活性槽、水

洗槽、下地めっき槽、Pdめっき槽、Auフラッシュめっき槽、水洗槽に連続的に通して、SUS301条表面に下地層、Pd層、Au層をこの順に形成してPd被覆ステンレス鋼を製造した。ここで、各層の厚さは種々に変化させた。一部のものは高級脂肪族アミンまたはメルカプタンを所定量含む処理液に浸漬して表面処理を行った。

【0014】（実施例2）Auフラッシュめっき槽を通さずに、SUS301条表面に下地層、Pd層をこの順に形成した他は、実施例1と同じ方法によりPd被覆ステンレス鋼を製造した。

【0015】得られた各々のPd被覆ステンレス鋼を皿ばね接点に加工し、これをタクティルアッシュスイッチの可動接点に組込んで寿命試験を行った。ここで、固定接点にはAgを1μm厚さに形成した黄銅材を用いた。C5210R条またはSUS301条表面にAuまたはAgをめっきした従来品についても同様の寿命試験を行った。試験条件は、動作速度を1Hz、最大打鍵回数を200万回、試験環境を大気中、80°Cの空気炉中、H₂Sガス（常温）中の3通りとした。1万回打鍵毎に接触抵抗を測定し、接触抵抗が500mΩを超えた回数をスイッチ寿命とした。結果を表1、2に皿ばねの構成を、表3、4にスイッチ寿命を示す。表3、4には皿ばねが破断した打鍵回数を併記した。

【0016】

【表1】

分類	No	基材	下地層 μm	Pd層 μm	Au,Ag 層 μm	表面処理 処理剤/濃度/時間
本 発 明 例 品	1	SUS -301 条	Ni 0.05	Pd 0.1	---	-----
	2		Ni 0.2	Pd-10%Ni 0.1	---	-----
	3		Ni 0.5	Pd 0.1	---	-----
	4		Ni 1.0	Pd 0.1	---	-----
	5		Ni 1.0	Pd 0.01	---	-----
	6		Co 1.0	Pd 0.05	---	アロシルメルカプタン /0.1%/5秒
	7		Ni-10%Co 1.0	Pd 0.5	---	-----
	8		Ni 1.0	Pd 0.1	---	ドデシルアミン /0.5%/5秒
	9		Ni 1.0	Pd 0.1	Au 0.001	-----
	10		Ni 1.0	Pd 0.1	Au 0.01	-----

(注) No.1~8 : 実施例2、No.9~10 : 実施例1。

【0017】

* * 【表2】

分類	No	基材	下地層 μm	Pd層 μm	Au,Ag 層 μm	表面処理 処理剤/濃度/時間
本 發 明 例 品	11	SUS 301 条	Ni 1.0	Pd 0.1	Au 0.05	ドデシルメルカプン /0.3%/5秒
	12		Ni 0.1	Pd 0.1	Au 0.2	---
	13		Ni 0.2	Pd 0.005	---	-----
	14		Ni 0.04	Pd 0.05	---	-----
	21		Ni 1.0	Pd 2.0	---	-----
	22		Ni 4.0	Pd 0.1	---	-----
従 来 品	16	C 5210	---	---	Au 0.01	-----
	17		---	---	Ag 1.0	-----
	18	SUS 301 条	---	---	Au 0.05	-----
	19		---	---	Ag 1.0	-----

(注) No.11~12: 実施例1、No.13,14,21,22: 実施例2。

【0018】

* * 【表3】

分類	No	スイッチ寿命 (接触抵抗が500mΩを超えた回数)			ばね破断回数 (常温) 回
		常温	80°C	H ₂ S 3ppm	
本 發 明 例 品	1	120×10 ⁶	131×10 ⁶	104×10 ⁶	>200×10 ⁶
	2	172×10 ⁶	107×10 ⁶	132×10 ⁶	"
	3	151×10 ⁶	148×10 ⁶	121×10 ⁶	"
	4	142×10 ⁶	154×10 ⁶	137×10 ⁶	"
	5	105×10 ⁶	112×10 ⁶	106×10 ⁶	"
	6	169×10 ⁶	>200×10 ⁶	193×10 ⁶	"
	7	>200×10 ⁶	>200×10 ⁶	>200×10 ⁶	"
	8	>200×10 ⁶	189×10 ⁶	>200×10 ⁶	"
	9	173×10 ⁶	160×10 ⁶	169×10 ⁶	"
	10	186×10 ⁶	>200×10 ⁶	>200×10 ⁶	"

(注) No.1~8 : 実施例2、No.9~10 : 実施例1。

【0019】

* * 【表4】

11

12

分類	No	スイッチ寿命 (接触抵抗が500mΩを超えた回数)			ばね破断回数 (常温) 回
		常温	80°C	H ₂ S 3ppm	
本発明例品	11	> 200×10 ⁶	> 200×10 ⁶	> 200×10 ⁶	> 200×10 ⁶
	12	> 200×10 ⁶	> 200×10 ⁶	192×10 ⁶	> 200×10 ⁶
	13	90×10 ⁶	86×10 ⁶	69×10 ⁶	190×10 ⁶
	14	83×10 ⁶	74×10 ⁶	61×10 ⁶	170×10 ⁶
	21	> 200×10 ⁶	> 200×10 ⁶	> 200×10 ⁶	> 200×10 ⁶
	22	175×10 ⁶	110×10 ⁶	120×10 ⁶	> 200×10 ⁶
従来品	16	44×10 ⁶	31×10 ⁶	27×10 ⁶	80×10 ⁶
	17	23×10 ⁶	12×10 ⁶	19×10 ⁶	75×10 ⁶
	18	65×10 ⁶	52×10 ⁶	45×10 ⁶	172×10 ⁶
	19	62×10 ⁶	37×10 ⁶	42×10 ⁶	170×10 ⁶

(注) No.11~12: 実施例1、No.13,14,21,22: 実施例2。

【0020】表3、4より明らかなように、本発明例品のNo.1~14,21,22はいずれもスイッチ寿命が従来品(No.16~19)より長く、中でも、Pd層を厚く形成したもの(No.7,21)、Au層を厚く形成したもの(No.10,12)、表面処理したもの(No.6,8)、Au層を形成しさらに表面処理したもの(No.11)は特に優れた寿命特性を示した。Pd層が薄めのNo.13と、下地層が薄めのNo.14とはスイッチ寿命およびばね破断回数が若干低下したが、実用上問題ない程度であった。

【0021】

【発明の効果】以上に述べたように、本発明の皿ばね接*

*点は、ステンレス鋼基材上にNiなどの下地層を、その上にPd層を形成したPd被覆ステンレス鋼、または前記Pd層上にさらにAuをフラッシュめっきしたPd被覆ステンレス鋼からなり、前記Pd層は接触抵抗が安定して低いため接点部に凝着磨耗などが起き難い。また前記Pd被覆ステンレス鋼を所定の処理液で表面処理したものは凝着磨耗などがさらに起き難い。従って、本発明の皿ばね接点を用いたスイッチは寿命が長く信頼性が高い。また本発明の皿ばね接点は小型化に適しタクティルプッシュスイッチの可動接点などとして広い用途に適用できる。依って、工業上顯著な効果を奏する。